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(54) FINE PARTICLE FOR ABRADING CHEMICAL MACHINERY AND PRODUCTION THEREOF AND ABRADING METHOD USING THE SAME

(57)Abstract:
PURPOSE: To obtain the fine particles uniform in size, almost spherical in shape, also optimized in hardness and providing no mechanical damage on the surface to be abraded of a substrate even if an abrasion is made therewith.
CONSTITUTION: An organometallic compound having metal-oxygen interatomic bond is subjected to emulsion polymerization to form metal oxide compound fine particles relatively low in hardness followed by forming therearound a metal oxide compound relatively high in hardness in a similar way, thus obtaining the fine particles optimized in hardness. For the present fine particles, the size distribution is limited within the range of average size 50% and the shape is almost spherical. By using a slurry containing the present fine particles, a substrate is subjected to chemical machinery abrasion to smooth this substrate.

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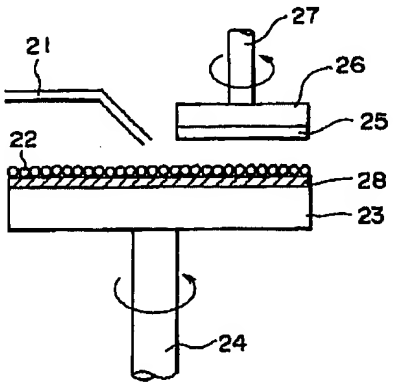
Drawing selection drawing 1



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CLAIMS

[Claim(s)]
[Claim 1] The particle for chemical machinery polish which it comes to consist of at least one kind of metallic-oxide system compounds, and particle size distribution are suppressed by less than **50% of average grain size, and is characterized by a configuration being approximate spherical.
[Claim 2] The particle for chemical machinery polish according to claim 1 characterized by coming to consist of two or more kinds of metallic-oxide system compounds with which degrees of hardness differ.
[Claim 3] The particle for chemical machinery polish according to claim 2 characterized by coming to cover the particle of a metallic-oxide system compound with a small degree of hardness with the layer of a metallic-oxide system compound with a large degree of hardness relatively.
[Claim 4] The manufacture approach of the particle for chemical machinery polish characterized by facing manufacturing the particle for chemical machinery polish according to claim 1, carrying out the emulsion polymerization of at least one kind of organometallic compound which has a metal-oxygen interatomic bond for said metallic-oxide system compound, and making it generate.

[Claim 5] The manufacture approach of the particle for chemical machinery polish characterized by facing manufacturing the particle for chemical machinery polish according to claim 2, carrying out the emulsion polymerization of at least two kinds of organometallic compounds which have a metal-oxygen interatomic bond for said two or more kinds of metallic-oxide system compounds, and making it generate.
[Claim 6] The manufacture approach of the particle for chemical machinery polish characterized by said thing [making a metallic-oxide system compound with a large degree of hardness generate similarly relatively] around this particle after facing manufacturing the particle for chemical machinery polish according to claim 3, carrying out the emulsion polymerization of said organometallic compound which has a metal-oxygen interatomic bond for the particle of a metallic-oxide system compound with a small degree of hardness relatively and making it generate.
[Claim 7] The manufacture approach of the particle for chemical machinery polish given in any 1 term of claim 4 characterized by stopping said emulsion polymerization by adding a terminator, and controlling the grain size of said metallic-oxide system compound thru/or claim 6.
[Claim 8] The manufacture approach of the particle for chemical machinery polish given in any 1 term of claim 4 characterized by said organometallic compound being an organic Si compound which has Si-O association thru/or claim 7.
[Claim 9] The polish approach characterized by performing chemical machinery polish of a substrate using the slurry which contains the particle for chemical machinery polish of a publication in any 1 term of claim 1 thru/or claim 3, and performing flattening of this substrate.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the polish approach that the particle size and the configuration of the particle for chemical machinery polish and this particle for chemical machinery polish which are contained in the slurry used for a chemical machinery polish (CMP) process used that controllable manufacture approach and the slurry containing this particle for chemical machinery polish for altitude further and of not doing damage to abrasives-ed, among the manufacture process of a semiconductor device.
[0002]
[Description of the Prior Art] In recent years, in the field of a semiconductor device, large capacity-ization of a device is progressing, and in order to make a chip area as small as possible and to attain large capacity-ization, the multilayer-interconnection technique is important. In this multilayer-interconnection technique, flattening of a substrate is needed. It is because un-arranging, such as the so-called stage piece with which a level difference arises by this and wiring formed on this level difference goes out, will occur if irregularity is in a substrate. In order to perform this flattening good, flattening from an initial process is important.
[0003] In the manufacture process of a common semiconductor device, the process which irregularity may generate on a substrate first is an isolation process. Although a component isolation region is formed by the selective oxidation of a silicon substrate, and the so-called LOCOS method, as for the component isolation region formed by this approach, it is more common than a component formation field that one step becomes high. Then, in order to prevent generating of the irregularity in an isolation process, flattening by trench isolation is proposed. Trench isolation embeds an insulator layer in the slot (trench) formed in the semi-conductor substrate, and performs isolation. And after embedding the above-mentioned insulator layer, flattening of the substrate front face is carried out by removing the heights which consist of an insulator layer formed in addition to the slot.
[0004] Chemical machinery polish (hereafter referred to as CMP.) is applied to removal of heights which consists of the above-mentioned insulator layer. In this polish approach, supplying a slurry on the abrasive cloth stretched by the rotation surface plate, the polished surface-ed of the wafer with which the insulator layer was formed in this abrasive cloth as mentioned above is made to ****, and flattening of a wafer is performed.
[0005] In addition, the thing which made the potassium-hydroxide water solution etc. usually distribute as a slurry the particle for polish which consists of metallic oxides, such as a silica (SiO2) with a particle size of about 10nm, an alumina (aluminum 2O3), titanium oxide (TiO2), and cerium oxide (CeO2), is used. Generally an above-mentioned metallic oxide is formed of elevated-temperature gaseous-phase hydrolysis. For example, if a JIKUKURO silane is introduced into the flame 1000 degrees C or more by oxygen/hydrogen burner and elevated-temperature gaseous-phase hydrolysis is made to cause, powder-like fumed silica will be obtained.
[0006] Here, the example which applied CMP to the formation process of trench isolation is explained using drawing 2 , drawing 3 , and drawing 5. First, as shown in drawing 2 , after forming thin silicon oxide 12 and the silicon nitride 13 on a silicon substrate 11, a slot 15 is formed by the photolithography and reactive ion etching (RIE), and the wall oxide film 14 is formed in the base and side face of a slot 15 by thermal oxidation after that.
[0007] Subsequently, as shown in drawing 3 , the insulator layer 16 which consists of an oxidation silicone film by the plasma CVD using the tetra-ethoxy silane (TEOS) which is organic Si compound is formed.
[0008] Furthermore, when polish removal is carried out by CMP by using the silicon nitride 13 as a stopper, as the insulator layer 16 above a slot 15 is shown in drawing 4 , flattening of the insulator layer 16 is carried out, and it will be in the condition of having been embedded to the interior of a slot 15.

[0009]
[Problem(s) to be Solved by the Invention] By the way, since the particle for polish contained in the slurry used for above-mentioned CMP was formed by elevated-temperature gaseous-phase hydrolysis, it is carrying out the shape of an indeterminate form, and its irregularity on the front face of a particle is also large. Moreover, the particle size distribution attain to **100% or more of average grain size, and its particle size is uneven.
[0010] And if irregularity is large and grinds a wafer using the slurry in which particle size distribution also contain the big particle for polish in this way, it will be easy to do physical damage on a scratch etc. to the polished surface-ed of a wafer. And when HF processing is carried out to a polished surface-ed as a removal process of the slurry after polish to the wafer which has a scratch, pervasion of a wafer takes place from this scratch, and a polished surface-ed may carry out surface roughening. Since very strict flattening is especially needed for the flattening process in the manufacture process of a semiconductor device, the surface roughening of the above polished surfaces-ed is connected also with, for example, degrading the dependability of the wiring formation which is degree process.
[0011] Then, surface irregularity is small and this invention aims at offering the manufacture approach of such a particle for chemical machinery polish for the purpose of offering the particle for chemical machinery polish to which particle size was equal so that it can grind without being proposed in view of this conventional actual condition, and doing physical damage to the polished surface-ed of a substrate. Furthermore, it aims at offering the polish approach using the slurry containing this particle for chemical machinery polish.
[0012]
[Means for Solving the Problem] This invention is proposed in order to attain the above-mentioned purpose. That is, it comes to consist of the particle for chemical machinery polish concerning this invention at least one kind of metallic-oxide system compounds, particle size distribution are suppressed by less than **50% of average grain size, and a configuration is an approximate spherical thing.
[0013] This particle for chemical machinery polish may consist of two or more kinds of metallic-oxide system compounds with which degrees of hardness differ. In this case, the particle for chemical machinery polish may be used as two or more kinds of the mixture or mixed crystal of a metallic-oxide system compound, and the particle of a metallic-oxide system compound with a small degree of hardness may be relatively considered as the configuration relatively covered with the layer of a metallic-oxide system compound with a large degree of hardness. In addition, the degree of hardness as a particle for chemical machinery polish is controllable by such an ingredient of a metallic-oxide system compound and a difference in structure.
[0014] If it is the compound which consists of metal-oxygen interatomic bonds as said metallic-oxide system compound, not to be necessarily the metallic oxide which has a stoichiometry-presentation, for example, what is necessary is just the compound constituted by association between metal atoms, such as Si, germanium, aluminum, Ti, and Ce, and an oxygen atom.
[0015] And the manufacture approach of the particle for chemical machinery polish concerning this invention is generated by carrying out the emulsion polymerization of at least one kind of organometallic compound which has a metal-oxygen interatomic bond for said metallic-oxide system compound.
[0016] What is necessary is to use the organometallic compound used as the raw material of each metallic-oxide system compound for coincidence, and just to carry out an emulsion polymerization, in manufacturing the particle for chemical machinery polish which consists of two or more kinds of the mixture or mixed crystal of a metallic-oxide system compound that what is necessary is just to carry out the emulsion polymerization of two or more kinds of organometallic compounds which have a metal-oxygen interatomic bond, in order to manufacture the particle for chemical machinery polish which consists of two or more kinds of metallic-oxide system compounds with which degrees of hardness differ.
[0017] What is necessary is on the other hand, just to make a metallic-oxide system compound with a large degree of hardness generate similarly relatively [perimeter / of this particle] relatively first, when the particle of a metallic-oxide system compound with a small degree of

hardness manufactures relatively the particle for chemical machinery polish relatively covered with the layer of a metallic-oxide system compound with a large degree of hardness, after carrying out the emulsion polymerization of the organometallic compound which has a metal-oxygen interatomic bond for the particle of a metallic-oxide system compound with a small degree of hardness and making it generate.

[0018] By the way, what is necessary is to form in a surfactant and this aqueous phase the micell which consists of an insoluble solvent into the aqueous phase, to distribute the organometallic compound used as the raw material of a metallic-oxide system compound in the above-mentioned micell, and just to make an organometallic compound cause hydrolysis by osmosis of the water into a micell first, in order to make a metallic-oxide system compound generate by the emulsion-polymerization method. In addition, it is desirable to have the molecular structure which all the joint hands that a metal atom has have combined with the oxygen atom as an organometallic compound, and an organic substituent combines with a metal atom through this oxygen atom. The organometallic compound which has such the molecular structure turns into a metallic-oxide system compound which has the chemical structure which repeats metal-oxygen association, when an organic substituent ****s by hydrolysis.

[0019] Thus, if hydrolysis is advanced within a micell, the particle shape of the metallic-oxide system compound generated according to approximate spherical and the made micell configuration in response to the uniform pressure from the perimeter will also turn into approximate spherical. Moreover, the particle size of the metallic-oxide system compound generated in this interior is also controllable with the magnitude of this micell.

[0020] In addition, although a presentation and degree of hardness of the generated metallic-oxide system compound are controllable by the molecular structure of the organometallic compound used as a raw material, the conditions of hydrolysis, etc., after generation, by calcinating, it can bring close to a stoichiometry-presentation and a degree of hardness is also raised.

[0021] As an organometallic compound which is a raw material, the thing containing metal atoms, such as Si, germanium, aluminum, Ti, and Ce, is usable, and when these are used, the metallic-oxide system compound which consists of metal-oxygen interatomic bonds, such as Si, germanium, aluminum, Ti, and Ce, is generated respectively. It is easy to apply especially the metallic-oxide system compound containing Si atom as a particle for chemical machinery polish. In addition, in order to generate the metallic-oxide system compound containing Si atom, all the four joint hands of Si atom are suitable, using organic Si compound combined with an organic substituent through O atom as a raw material. Specifically, annular polysiloxanes, such as chain-like polysiloxanes, such as alkoxy acetoxysilane, such as alkoxysilane, such as a tetramethoxy silane, a tetra-ethoxy silane, tetra-isopropoxysilane, and tetra-TASHARU butoxysilane, and a JIISO propoxy diacetoxy silane, and hexa methyl disiloxane, octamethylcyclotetrasiloxane, and a tetramethyl cyclo TERORA siloxane, etc. are mentioned.

[0022] In addition, by adding a terminator for a metallic-oxide system compound during generation in an emulsion polymerization, a reaction may be stopped and grain size of a metallic-oxide system compound may be controlled. As for a terminator, it is desirable that it is the organometallic compound which has the molecular structure which contains the same metal atom as the organometallic compound which is the raw material of a metallic-oxide system compound, one of the joint hands which this metal atom has combines with an organic substituent through an oxygen atom, and an organic substituent couples directly with all other joint hands. Although the joint hand which the organic substituent has combined through an oxygen atom will be combined with the resultant of the organometallic compounds which are raw materials if such a terminator is added, it becomes impossible for the organometallic compounds which are raw materials to react more than it as a result, since the joint hand which the organic substituent couples directly cannot combine the above-mentioned resultant. For example, when making the metallic-oxide system compounds containing Si atom react and making the metallic-oxide system compound generate, a reaction can be stopped by using as a terminator the compound which has one alkoxyl group and three alkyl groups, such as triethylmethoxysilane.

[0023] As an ingredient of the surface active agent used in order to form a micell into the

aqueous phase, the nonionic active agents and the conventionally well-known cationics activators which made a polyethylene glycol and polyhydric alcohol the hydrophilic group, such as the ether or ester, a sorbitan fatty acid ester, and a fatty-acid monoglyceride, are usable. If it illustrates, stearin acid, stearin acid polyethylene oxide, lauric-acid polyethylene oxide, nonyl phenol ethylene oxide, oleic acid polyethylene oxide, stearyl amine ethylene oxide, oleic amide ethylene oxide, polypropylene-glycol ethylene oxide, glycerol lauric-acid monoester, pentaerythritol monostearin acid ester, sorbitol palmitic-acid monoester, lauric-acid diethanolamide, etc. will be mentioned as a nonionic active agent. As a cationics activator, dimethylannmonium chloride, tetramethyl ammoniumchloride, lauryl methylanmmonium chloride, lauryl trimethylammonium chloride, monoethanolamine monostearate, triethanolamine monostearate, a hydroxyethyl stearyl amine, etc. are mentioned.

[0024] In addition, in order to generate an above-mentioned metallic-oxide system compound, a suspension-polymerization method may be applied instead of an emulsion-polymerization method. Also in this case, it is possible by adjusting whenever [suspension] to control particle size. Moreover, about the stability of suspension, it is maintainable by churning or bubbling.

[0025] And the polish approach concerning this invention uses for flattening of the substrate by chemical machinery polish the slurry containing the particle for chemical machinery polish manufactured as mentioned above.

[0026] Chemical machinery polish progresses according to the synergistic effect of the mechanical polish force by the particle for chemical machinery polish in the abrasive cloth stretched on the rotation surface plate or a slurry and the polished surface-ed of a substrate ****ing, and the chemical polish force by the lytic reaction by the alkali water solution in a slurry etc. The above-mentioned particle for chemical machinery polish is distributed by polish liquid, such as an alkali water solution, in the above-mentioned slurry. If particle size is uniform as mentioned above as this particle for chemical machinery polish, and an approximate spherical thing is used, since the particle for chemical machinery polish will **** to the polished surface-ed of a substrate by the uniform polish force, it is hard to make the polished surface-ed of this substrate produce a scratch.

[0027] Such polish is used for the manufacture process of a semiconductor device, is suitable, for example, is faced forming the component isolation region by which flattening was carried out, and when removing an upper part part from this slot of the insulator layer formed on the semi-conductor substrate which has a slot, it can be applied. Moreover, it is effective also when forming the so-called embedding plug which embeds an electrical conducting material at the connection hole for aiming at connection during vertical wiring. In addition, it is good to form a wear-resistant layer with a polish rate later than an insulator layer in substrate front faces other than a slot in the case of the former, to form a wear-resistant layer with a polish rate later than an electrical conducting material layer in substrate front faces other than a connection hole, when it is the latter, and to use this wear-resistant layer as a stopper to polish, respectively. Furthermore, it faces carrying out flattening of the insulator layer formed on the wafer which has a level difference, and this invention may be applied.

[0028]

[Function] The manufacture approach of the particle for chemical machinery polish of this invention is applied, if the emulsion polymerization of the organometallic compound which has a metal-oxygen interatomic bond is carried out and a metallic-oxide system compound is made to generate, particle size is equalized and a configuration can generate an approximate spherical metallic-oxide system compound easily.

[0029] Particle size can be equalized because the particle size of the metallic-oxide system compound which the magnitude of a micell can control by various conditions, such as a class of insoluble solvent, an addition, the class of surfactant and an addition, and an agitating speed, in the water in the aqueous phase, and generates in this interior with the magnitude of this micell is also controllable. Moreover, a configuration turns into approximate spherical, because the micell serves as approximate spherical in response to the uniform pressure from the perimeter.

[0030] Furthermore, the degree of hardness of the manufactured particle for chemical machinery polish is also controllable by applying this invention. It becomes possible [it is possible to obtain

that from which a degree of hardness differs by selection of a raw material in generating a metallic-oxide system compound by using one kind of organometallic compound as a raw material, and], when manufacturing the particle for chemical machinery polish which is made to generate two or more kinds of metallic-oxide system compounds using two or more kinds of organometallic compounds, respectively, and consists of mixture or mixed crystal to control a degree of hardness by selection of a raw material, and its mixing ratio. Moreover, also when making a metallic-oxide system compound generate by using as a raw material an organometallic compound which is different to the perimeter and manufacturing the particle for chemical machinery polish after generating a metallic-oxide system compound by using a certain organometallic compound as a raw material, it becomes possible to control a degree of hardness by selection of a raw material, and the amount of each metallic-oxide system compound, respectively.

[0031] And this invention is applied, and if particle size is uniform and a configuration performs chemical machinery polish using the approximate spherical particle for chemical machinery polish, this particle for chemical machinery polish can be made to **** to the polished surface-ed of a substrate by the uniform polish force. Moreover, since the degree of hardness of the particle for chemical machinery polish can be optimized, the polish force and a polish rate can also be optimized. For this reason, generating of the scratch in the polished surface-ed of a substrate can be controlled.

[0032]

[Example] Hereafter, a concrete example is given and explained about the particle for chemical machinery polish concerning this invention, its manufacture approach, and the polish approach using this.

[0033] One or less example, the example of the manufacture approach of the particle for chemical machinery polish, and the manufactured property of the particle for chemical machinery polish are explained. In this example, the particle for chemical machinery polish which consists of an Si oxide system compound which consists of Si-O association was manufactured.

[0034] First, 1ml stearin acid was added to 1l. pure water, 10ml n-hexane was agitated to it, and, specifically, the micell was formed. In addition, the magnitude of the formed micell was an average of 10nm. Then, after adding 10ml of tetra-ethoxy silanes and making it distribute in the above-mentioned micell, it heated at 100 degrees C. By this, water permeated into the micell, the hydrolysis reaction advanced, and Si oxide system compound generated.

[0035] Si oxide system ingredient which rinsed the above-mentioned Si oxide system compound after reaction termination, and removed n-hexane and stearin acid, then was obtained was calcinated at 800 degrees C for 30 minutes.

[0036] The particle for chemical machinery polish which consists of an Si oxide system compound as mentioned above was obtained. In addition, as a result of measuring particle size with light scattering measurement, it was 10nm**50%, and the configuration was approximate spherical when observed with the electron microscope.

[0037] In example 2 this example, the particle for chemical machinery polish by which particle size was further equalized rather than what was manufactured in the example 1 was manufactured.

[0038] First, 10ml n-hexane and 0.5ml pentaerythritol monostearin acid ester were added and agitated to 1l. pure water, and, specifically, the micell was formed. In addition, the magnitude of the formed micell was an average of 10nm. Then, after adding 10ml of tetramethyl cyclotetrasiloxane and making it distribute in the above-mentioned micell, it heated at 100 degrees C. Water permeated into the micell, the hydrolysis reaction occurred, and generation of Si oxide system compound was started by this. Furthermore, in this example, 1ml of trimethylethoxysilane was added as a terminator after 30 minutes, and the hydrolysis reaction was stopped.

[0039] Then, Si oxide system ingredient which rinsed, and removed n-hexane and pentaerythritol monostearin acid ester, then was obtained was calcinated at 800 degrees C for 30 minutes.

[0040] The particle for chemical machinery polish which consists of an Si oxide system compound as mentioned above was obtained. In addition, as a result of measuring particle size

with light scattering measurement, it was 10nm**20%, and the configuration was approximate spherical when observed with the electron microscope.
[0041] In addition, in this example, by addition of a terminator, since ********* was regulated from hydrolysis, the particle for chemical machinery polish by which particle size was further equalized rather than the example 1 has been manufactured.
[0042] In example 3 this example, the particle for chemical machinery polish by which the degree of hardness was reduced rather than what was manufactured in the example 1 was manufactured.
[0043] First, 1ml stearin acid was added to 1l. pure water, 10ml n-hexane was agitated to it, and, specifically, the micell was formed. In addition, the magnitude of the formed micell was an average of 10nm. Then, after adding tetra-ethoxy silane 5ml and tetramethoxy germanium 5ml and making it distribute in the above-mentioned micell, it heated at 100 degrees C. By this, water permeated into the micell, the hydrolysis reaction advanced, and the mixture of Si oxide system compound and germanium oxide system compound generated.
[0044] The mixture which rinsed the above-mentioned mixture after reaction termination, and removed n-hexane and stearin acid, then was obtained was calcinated at 700 degrees C for 30 minutes.
[0045] The particle for chemical machinery polish which consists of mixture of Si oxide system compound and germanium oxide system compound as mentioned above was obtained. In addition, as a result of measuring particle size with light scattering measurement, it was 10nm**50%, and the configuration was approximate spherical when observed with the electron microscope.
[0046] In addition, as compared with the oxide system ingredient of Si, since the oxide system ingredient of germanium had the low degree of hardness, the particle for chemical machinery polish obtained as mentioned above became that by which the degree of hardness was reduced from what was manufactured in the example 1.
[0047] In example 4 this example, the particle for chemical machinery polish with a degree of hardness higher than what was manufactured in the example 1 was manufactured.
[0048] First, 10ml n-hexane and 0.5ml pentaerythritol monostearin acid ester were added and agitated to 1l. pure water, and, specifically, the micell was formed. In addition, the magnitude of the formed micell was an average of 10nm. Then, after adding 10ml of tetramethyl cyclotetrasiloxane and making it distribute in the above-mentioned micell, it heated at 100 degrees C. Water permeated into the micell, the hydrolysis reaction occurred, and generation of Si oxide system compound was started by this. furthermore, this example -- setting -- after 30 minutes and TORITASHARUBU -- an ibis -- 10ml of sial miniums was added and it was made to distribute in the above-mentioned micell thereby -- TORITASHARUBU -- an ibis -- the hydrolysis reaction of sial minium occurred and aluminum oxide system compound generated around [which consists of an Si oxide system compound within a micell] the particle.
[0049] The mixture which rinsed the above-mentioned mixture after reaction termination, and removed n-hexane and pentaerythritol monostearin acid ester, then was obtained was calcinated at 800 degrees C for 30 minutes.
[0050] The particle for chemical machinery polish with which aluminum oxide system compound comes to cover the particle which consists of an Si oxide system compound as mentioned above was obtained. In addition, as a result of measuring particle size with light scattering measurement, it was 10nm**50%, and the configuration was approximate spherical when observed with the electron microscope.
[0051] In addition, as compared with the oxide system ingredient of Si, since the oxide system ingredient of aluminum had the high degree of hardness, the particle for chemical machinery polish obtained as mentioned above became what has the polish force higher than what was manufactured in the example 1.
[0052] Example 5 this example explains the polish approach using the particle for chemical machinery polish manufactured as mentioned above.
[0053] Here, in advance of explanation of the actual polish approach, the example of a configuration of the polish equipment used for this polish is explained, referring to drawing 1 . This polish equipment consists of a substrate attaching part which turns the polished surface-ed

of a substrate 25 down, and holds this, and the substrate 25 which was located under this substrate attaching part and held at this substrate attaching part and the substrate polish section made to ****.
[0054] The above-mentioned substrate attaching part consists of a maintenance base revolving shaft 27 which forms this substrate maintenance base 26 with drives, such as the substrate maintenance base 26 which has the substrate installation side which carries out adhesion maintenance of the substrate 25, and consists of a metallic material, and a motor which is not illustrated, as it is pivotable.
[0055] On the other hand, the substrate polish section consists of a slurry supply pipe 21 for supplying the surface plate revolving shaft 24 and slurry 22 which make the above-mentioned rotation surface plate 23 with drives, such as the abrasive cloth 28 for laying a slurry 22, the rotation surface plate 23 with which this abrasive cloth 28 was stretched, and a motor which is not illustrated, as it is pivotable on abrasive cloth 28.
[0056] In order to actually grind using such polish equipment, the KOH water solution of pH10.0 is made to distribute the particle for chemical machinery polish manufactured by carrying out like an example 1 first 30% of the weight, and the slurry 22 is prepared. On the other hand, a substrate 25 is made to hold on the substrate maintenance base 26, this is rotated around the maintenance base revolving shaft 27, and the rotation surface plate 23 is also rotated around the surface plate revolving shaft 24. And the polished surface-ed of a substrate 25 is ground by supplying the slurry 22 prepared as mentioned above on abrasive cloth 28 from the slurry supply pipe 21, and making the polished surface-ed and abrasive cloth of a substrate 25 **** on the following polish conditions.
[0057] Rotational frequency of a polish condition rotation surface plate Rotational frequency of 37rpm substrate maintenance base 17rpm polishing pressure force 5.5x103 Pa slurry flow rate A part for 225ml/[0058] Here, the above-mentioned polish approach was applied to removal of the insulator layer in the formation process of trench isolation. This process is explained using drawing 2 - drawing 4 . First, as shown in drawing 2 , after forming thin silicon oxide 12 and the silicon nitride 13 on a silicon substrate 11, the slot 15 was formed by the photolithography and reactive ion etching (RIE), and the wall oxide film 14 was formed in the base and side face of a slot 15 by thermal oxidation after that.
[0059] Subsequently, as shown in drawing 3 , the oxidation silicone film was formed on the following CVD conditions, and the insulator layer 16 was formed all over the wafer.
[0060]
Membrane formation conditions of an oxidation silicone film Material gas TEOS 1000sccm (helium bubbling)
O3 2000sccm Pressure 79800Pa (600Torr)
Temperature 390 degrees C [0061] Then, in order to carry out polish removal of the heights of the insulator layer 16 formed as mentioned above, the wafer was held on the substrate maintenance base 26 of polish equipment. And the polished surface-ed of a wafer was ground by the polish approach mentioned above.
[0062] Thereby, as shown in drawing 4 , the upper insulator layer 16 was removed from the slot 15 by using the silicon nitride 13 as a stopper. In addition, even if generating of a scratch was not seen but it removed the slurry by HF water solution after that in the polished surface-ed of a wafer, a wafer front face did not carry out surface roughening.
[0063] By making polish of a wafer as mentioned above, where it will be in the condition of having been embedded to the interior of the insulator layer 16 fang furrow 15, and there is no scratch and flattening is fully carried out, trench isolation has been formed.
[0064] In example 6 this example, the polish approach by which the polish force was suppressed rather than the polish approach shown in the example 5 is explained.
[0065] It grinds as polish conditions etc. being the same as an example 5 except having prepared the slurry 22 using the particle for chemical machinery polish manufactured in the example 3 instead of the particle for chemical machinery polish specifically manufactured in the example 1 using the same polish equipment with having been shown in the example 5.
[0066] Since the degree of hardness is smaller than what was manufactured in the example 1, if

the particle for chemical machinery polish manufactured in the example 3 grinds by the polish approach of this example, the polish by which the polish force was suppressed will be made rather than the polish approach shown in the example 5.
[0067] Here, it applied to removing an elastic thing from the insulator layer 16 shown in the example 5 in the formation process of trench isolation in this polish approach. The process which forms a slot 15 and specifically forms the wall oxide film 14 in this base and side face was performed like the example 5, and, subsequently formed the insulator layer 16 all over the wafer on the following CVD conditions.
[0068]
Membrane formation conditions of an oxidation silicone film Material gas TEOS 1000sccm (helium bubbling)
TMP 50sccm TMB 20sccm O3 2000sccm Pressure 79800Pa (600Torr)
Temperature 390 degrees C [0069] In addition, the formed insulator layer 16 was set to elastic BPSG from what was formed in the example 5.
[0070] Then, in order to carry out polish removal of the heights of the insulator layer 16 formed as mentioned above, the wafer was held on the substrate maintenance base 26 of polish equipment, the polish approach mentioned above was applied, and the polished surface-ed of a wafer was ground.
[0071] Thereby, as shown in drawing 4 , the upper insulator layer 16 was removed from the slot 15 by using the silicon nitride 13 as a stopper. In addition, in spite of having ground elastic BPSG, even if generating of a scratch was not seen but it removed the slurry by HF water solution after that in the polished surface-ed of a wafer, a wafer front face did not carry out surface roughening.
[0072] By making polish of a wafer as mentioned above, where it will be in the condition of having been embedded to the interior of the insulator layer 16 fang furrow 15, and there is no scratch and flattening is fully carried out, trench isolation has been formed.
[0073] As mentioned above, although the particle for chemical machinery polish concerning this invention, its manufacture approach, and the polish approach using this were explained, deformation modification is possible for this invention suitably in the range which is not limited to an above-mentioned example and does not deviate from the main point of this invention about the component or the manufacture approach of the particle for chemical machinery polish. Moreover, also in the polish equipment used, in order to raise the homogeneity within a field of polish, deformation of making possible partially temperature control of a rotation surface plate or a substrate maintenance base is possible. Furthermore, in the polish approach, although only the example using the particle for chemical machinery polish shown in the example 1 and the example 3 was given, of course, the particle for chemical machinery polish manufactured according to the example 2 or the example 4 may be used.
[0074] Moreover, it faces forming trench isolation with the application of the polish approach concerning this invention, and the ingredient which can be used as a stopper is not restricted to a silicon nitride, what is necessary is just an ingredient with a polish rate later than an insulator layer, and especially the membrane formation conditions of the oxidation silicone film which constitutes an insulator layer etc. are not limited.
[0075] Moreover, the polish approach concerning this invention is effective also when forming the so-called embedding plug which embeds an electrical conducting material at the connection hole for aiming at connection during vertical wiring besides formation of trench isolation. Furthermore, being applied to formation of the flattening film between layers etc., and securing a high polish rate, it has faced performing polish by which the damage to a substrate was controlled, and, in a gap, may be applied.
[0076]
[Effect of the Invention] If this invention is applied so that clearly from the above explanation, particle size is uniform, and a configuration can manufacture the approximate spherical particle for chemical machinery polish, and can also adjust the degree of hardness of this particle for chemical machinery polish further. For this reason, it can grind by the optimized polish force, without doing physical damage to the polished surface-ed of a substrate, if this is used for a

slurry.

[0077] Therefore, if this invention is applied to flattening in the manufacture process of a semiconductor device, since it will become possible to attain sufficient flattening, without doing damage, multilayer-interconnection-ization of a semiconductor device is advanced and further high integration is also enabled.

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the mimetic diagram showing the example of 1 configuration of the polish equipment used for this invention.
[Drawing 2] In the formation process of trench isolation, it is the sectional view showing the condition that formed the slot in the silicon substrate in which silicon oxide and a silicon nitride were formed, and the wall oxide film was formed in the base and side face of a slot.
[Drawing 3] It is the sectional view showing the condition of having formed the insulator layer to the wafer of drawing 2 .
[Drawing 4] It is the sectional view showing the condition of having ground until the silicon nitride exposed the insulator layer of the wafer of drawing 3 .
[Description of Notations]
11 Silicon Substrate
12 Silicon Oxide
13 Silicon Nitride
14 Wall Oxide Film
15 Slot
16 Insulator Layer
21 Slurry Supply Pipe
22 Slurry
23 Rotation Surface Plate
24 Surface Plate Revolving Shaft
25 Substrate
26 Substrate Maintenance Base
27 Maintenance Base Revolving Shaft
28 Abrasive Cloth

[Translation done.]